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ABSTRACT

Data from the 1985-86 Peru Living Standards Survey were used to analyze the targeting of public education expenditures and the effects on enrollment of public school fees and reduced travel time to secondary schools. This chapter also focuses on strengths and weaknesses of using either an estimation-based measure of benefit or a nonestimation-based approach (benefit-incidence analysis) to assess household willingness to pay for education. Educational benefits were found to be mildly pro-poor in Peru. However, a much lower proportion of poor children aged 6-12 were enrolled in elementary schools compared to other income groups. Females as a group received fewer expenditures than males as a result of differential enrollment rates. Elementary education benefits were higher in rural than urban areas, while the reverse was true at secondary and higher levels, in part because rural teenagers were more likely to be enrolled in elementary school. Also, a large fraction of poor teenagers overall were enrolled in elementary school. Out-of-pocket expenses such as uniforms were a barrier to participation for children in low-income households. Increasing school fees would be regressive as a percentage of household income, although the largest absolute losses would fall on middle-income households. Analysis of willingness to pay higher fees for better proximity to schools found that, although many rural households lived far from the nearest secondary school, the potential reduction in travel expenses would fall far short of the increased cost of schooling. However, the analysis neglected potential nonfinancial benefits of improved school proximity. Contains 49 references. (SV)

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Measuring the Distributional Effects of Public Education in Peru

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7 Measuring the Distributional Effects of Public Education in Peru

Thomas M. Selden and
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It has become widely recognized that education can play an important role in the development process and in the alleviation of poverty. However, in many countries, including Peru, important educational policy issues remain unresolved. For example, how effectively has public education spending been targeted to the poor? Is it more effective to expand enrollment through increased government expenditure on education, or should educational spending be targeted more specifically on a subset of the school-age population? Should greater emphasis be placed on primary education at the expense of secondary or higher education? Do males receive a larger share of public educational expenditure than females? Should school fees be increased—and if so, should the increased revenues be used to defray existing government expenditures or to finance further improvements in the quality of education? Even without fee increases, do substantial commuting, textbook, and uniform costs represent barriers to enrollment in primary school for children in the poorest households?

To help policymakers address these and similar questions, economists have strived for decades to provide improved measures of the benefits from education. Because it aligns with economic theory, the most natural approach for economists is to focus on benefit measures that involve areas underneath estimates of individual compensated demand curves. Using estimation-based approaches, behavioral changes induced by policy changes can be analyzed, and the private willingness to pay for such changes can be measured. This approach is best illustrated by recent research based on the World Bank's Living

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Standards Measurement Surveys, including Gertler and Glewwe's (1990, 1992) studies of Peruvian education.[1] However, although estimation-based approaches are generally preferred by economists, they have conceptual and practical limitations. For example, despite the increasing availability of household-level data, even the most detailed data frequently impose important constraints on the questions that estimation-based analyses can address.

In this chapter, we examine several alternative, nonestimation-based approaches to analyzing education and employ these measures in an empirical study of Peru. One well-known nonestimation-based approach is the benefit-incidence methodology applied in developing countries by Meerman (1979) and Selowsky (1979), among others.[2] By allocating government education outlays to households in proportion to enrollment in public schools, standard benefit-incidence analysis seeks to answer questions concerning the targeting of public expenditures.[3] Although the methodology is well understood, it is not well known that nonestimation-based methods can be used to examine a range of policy-relevant questions. In particular, we use alternative nonestimation-based methods to examine the incidence in Peru of (a) higher public school fees and (b) reduced travel time to public secondary schools.

Thus, the objective of this chapter is both methodological and empirical. First we present the theory underlying both the estimation-based and nonestimation-based approaches to measuring willingness to pay, examining not only standard benefit-incidence measures but also several alternative nonestimation-based measures. In particular, we focus on the strengths and weaknesses of both estimation- and nonestimation-based approaches within a discrete-choice context. We then employ the 1985–86 Peru Living Standards Survey (PLSS) data used by Gertler and Glewwe (1990, 1992) to analyze Peru's public education system with the presented nonestimation-based methods.

Theoretical Considerations

To clarify the theoretical issues involved in measuring the distributional effects of education, it is useful to begin with a highly simplified formal model, building on the work of Gertler and van der Gaag (1988) and Gertler and Glewwe (1990, 1992). For simplicity of exposition, we focus on the case in which the household faces a simple, binary decision of whether to send a child to public school or not send a child to school. However, the analysis can readily be expanded to include private schooling as a third option.

The household decisionmaker is assumed to have a utility function defined over the enrollment choice, $s \in \{0, 1\}$, school quality, q, and

other household consumption, $c \geq 0$: $U = U(sq, c)$. The decisionmaker's maximization problem, assuming no rationing, is

$$\max_{s} U\,[sq,\ c_0 - (p + wt)s], \tag{7-1}$$

where c_0 is household consumption without schooling, p is the household's total schooling expense (including school fees, uniform expenses, educational material expenses, and transportation expenses, all of which are assumed to be exogenous to the household), t is the amount of employment time forgone when attending school, and w is the child wage rate. For simplicity, we assume that schooling requires classroom time, t_S, and travel time, t_T, both of which are exogenous to the household.[4] Assuming that total schooling hours equal forgone employment, we have $t = t_S + t_T$.[5]

Solving the household problem yields the following *unconditional* indirect utility function:

$$V(p + wt, q, c_0) \equiv \max\,[U(0, c_0), U(q, c_0 - p - wt)]. \tag{7-2}$$

To derive compensating variation (CV) measures of benefit, it is also useful to derive the (unconditional) expenditure function:

$$e(p + wt, q, U) \equiv \min\,[c_0 \mid V(p + wt, q, c_0) \geq U] \tag{7-3}$$

and the compensated (or Hicksian) demand:

$$s^c(p + wt, q, U) = \frac{\partial e(p + wt, q, U)}{\partial(p + wt)}. \tag{7-4}$$

Because enrollment is a discrete choice, the compensated demand curve is a step function with values 0 and 1, for which one can define the compensated crossover price, $(p + wt)^*$, to be the highest level of $p + wt$ at which the child is enrolled in school (holding U constant).

Given these definitions and results, it is straightforward to expand the household's choice set to include both public and private schooling options (or some other policy-relevant set of choices), enabling one to pose the following three incidence questions. First, what is the incidence of benefits from public education (both on a per capita and a per child basis), by household expenditure decile, region, and gender, and what would be the incidence of a marginal reallocation of public funds from secondary and higher education to primary education? Second, what would be the incidence of an increase in schooling fees? Third, what would be the incidence of using higher school fees to finance the construction of additional, closer schools?

Measuring the Incidence of Benefits from Public Education

Within the context of the schooling decision model presented above, the household decisionmaker's net benefit from the public schooling option can be measured by the following compensating variation (CV_1):

$$CV_1 = \int_{p+wt}^{\infty} s^c(z, q, U)\, dz, \tag{7-5}$$

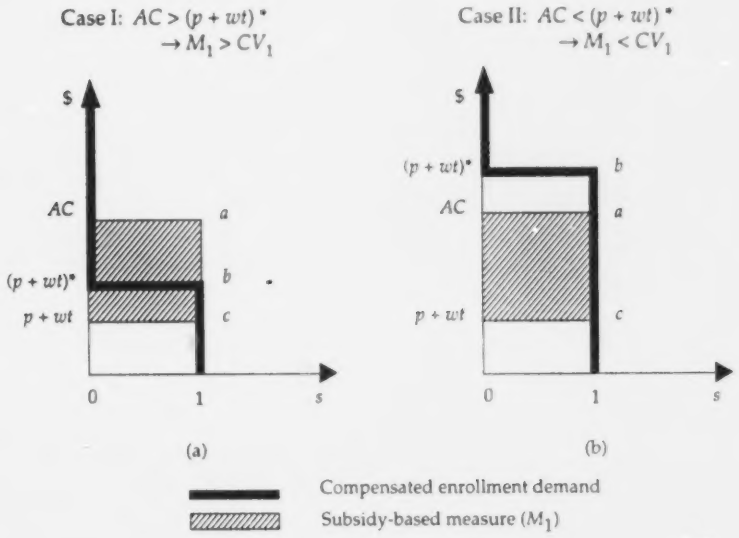
where U is the status quo level of utility and z is a variable for integration. Intuitively, CV_1 measures the disbenefit of eliminating the public schooling option from the household decisionmaker's choice set.[6] To assess the incidence of benefits, one might compute CV_1 for each eligible child in the sample and allocate benefits to households in proportion to their eligible children. Average benefits might then be compared among households grouped by income or other relevant socioeconomic characteristics.

AN ESTIMATION-BASED MEASURE OF BENEFIT. Following Small and Rosen (1981), Gertler and Glewwe (1990, 1992) use estimated discrete-choice probabilities to compute the expected value of CV_1 across the distribution of unobserved factors affecting schooling. The advantage of their approach is that it links well-known discrete-choice estimation methods with the computation of widely accepted benefit measures. Nevertheless, one may encounter difficulties in implementing this approach. For instance, the researcher must specify a functional form for utility and a distribution for the error terms in the model. These assumptions are typically difficult to justify a priori. In addition, this approach can be costly to implement.

Perhaps more important, demand estimation requires information on school fees (and other expenses) for all choices that a given individual faces (regardless of the individual's actual schooling decision). Such information is rarely available. For instance, this data requirement leads Gertler and Glewwe to analyze only the rural regions of Peru, because the PLSS urban data do not provide information on key components of the prices of alternative schooling choices, such as travel times and school fees. Similarly, they examine local versus faraway schooling, rather than public versus private schooling, because the data do not reveal private school prices unless the private schooling option is actually chosen.[7] Since they are unable to distinguish between public and private schooling, their analyses of fee increases and travel time reductions should be interpreted with caution.

BENEFIT-INCIDENCE ANALYSIS. An alternative, nonestimation-based approach to assessing the incidence of education benefits is to examine average government outlays per capita among households grouped by income or other relevant socioeconomic characteristics, as in standard benefit-incidence analysis. Although this approach is perhaps best interpreted as providing a perspective on the use of government funds, it is also possible to make a more formal comparison with CV_1. Let $AC = g + p + wt$ be the full economic cost (both government and

Figure 7-1. Potential Approximation Error from Standard Incidence Calculations



private) of the public schooling option, where g is the government's per pupil expenditure (plus any public scholarships received). The benefit-incidence measure for a given individual can be written as:

$$M_1 \equiv gs = [AC - (p + wt)]\, s, \tag{7-6}$$

where s is observed public school enrollment. If AC happens to equal the compensated crossover price at which households reject the public school option, then this nonestimation-based measure and the estimation-based measure discussed above coincide. Figure 7-1 illustrates the more likely cases in which M_1 either overestimates or underestimates CV_1. In graph a, AC exceeds the crossover price, so that M_1, the shaded region, exceeds CV_1, which is given by the rectangle $(p + wt)^*bc(p + wt)$. In graph b, AC is less than the crossover price, so that M_1 understates CV_1, which is again given by $(p + wt)^*bc(p + wt)$.

Crossover prices may vary among households, and M_1 may approximate CV_1 more closely for some households than for others. For example, one might expect that M_1 would tend to understate the willingness to pay of higher-income relative to lower-income households, because the compensated crossover prices are likely to be an increasing function of income. As a result, education benefits measured using M_1 would appear more pro-poor than they are in reality.

Another related problem with this standard approximation concerns quality differences among schools. Presumably, schools with higher quality will lead to greater net benefit, because the crossover price at which students no longer enroll will be higher. Quality can be explicitly incorporated into CV_1 to the extent that the researcher has access to data on differences in school quality for each of the options facing each household. In contrast, quality differences among schools are only indirectly incorporated in M_1 to the extent that such differences are captured by per pupil expenditure data. If, as is typically the case, the researcher only has access to national totals for government expenditures on primary, secondary, and higher education, then differences in quality will be ignored. Insofar as quality is positively related to per capita income, education benefits measured by M_1 would therefore appear to be more pro-poor than they are in reality.[8]

SOME CAVEATS REGARDING WILLINGNESS TO PAY. There is a long list of reasons why the private willingness to pay of household decisionmakers, either CV_1 or its approximation M_1, may be an overly restrictive measure of benefit. First, it is partial equilibrium (that is, other prices and incomes are held constant). Second, this measure ignores education externalities and the shifting of benefits to unintended parties.[9] Third, the incidence of education benefits is measured at a single point in time, rather than over the lifetimes of the individuals involved. Of course, the present value of the future stream of benefits may be partially captured in the current willingness to pay. However, this correspondence need not be exact due to imperfect information and credit constraints, particularly among the poor. Also, note that parents with children in school tend not to have reached their peak earnings. Transfers to such households from better-off households (some of which might simply be similar households in a later stage of life) may thus appear more progressive from a cross-sectional perspective than if viewed over the life cycle.[10] Fourth, parental willingness to pay may not adequately reflect the benefits children receive from education. At a more fundamental level, Sen (1987a, 1987b) argues for a "capabilities"-oriented approach, which might suggest in the present context a reduced emphasis on the willingness to pay for schooling and a greater emphasis on the abilities of individuals to pursue their education (see also Anand and Ravallion 1993). Although nonestimation-based approaches may not always provide accurate measures of willingness to pay, they are in some cases better suited than estimation-based methods for researchers whose interests extend beyond analyses based on willingness to pay. For instance, from a capabilities perspective, benefit-incidence analysis can be interpreted as offering evidence on the incidence of the government's contribution to participation in the

education process—as distinct from valuing such participation according to the household decisionmaker's willingness to pay.

PER CAPITA VERSUS PER CHILD MEASURES OF INCIDENCE. Whether one uses CV_1 or M_1 to measure the incidence of schooling benefit, an important issue is whether to examine benefits on a per capita or a per child basis. The benefit-incidence approach typically adopts a per capita focus, which is appropriate insofar as benefits from subsidized public schooling are at least partially shared by all household members. However, it is also true that household composition may vary substantially across the income distribution, with the highest concentrations of children typically being in the poorest household deciles (as is the case in Peru; see below). For this reason, public education may appear pro-poor in per capita analyses of spending even though poor children receive lower educational spending per child. It may therefore be useful to compute incidence on a per child basis, as well as on a per capita basis, in order to see how education outlays received by children depend on income. The per child analytical lens may be especially important if one adopts a capabilities approach that focuses on actual enrollment by children.

MARGINAL VERSUS TOTAL MEASURES OF INCIDENCE. Finally, note that both the estimation and nonestimation-based approaches presented above measure *total* rather than *marginal* benefits. The incidence of total benefits can provide insights into the government's overall contribution toward the reduction of inequality and poverty through educational spending. Strictly speaking, the aggregate analysis contributes to an understanding of the total expenditure on education and the implications of eliminating government expenditure. However, the elimination of public schooling is rarely the relevant policy alternative. More often, the debate surrounds a *marginal* reallocation of resources, either within the education sector (say, from higher to primary education) or between the education sector and the rest of the government budget (see, for instance, Psacharopoulos 1977; Mingat and Tan 1985, 1986, among others).

Of course, the total benefit measures may well offer useful insights for policymakers. A finding that primary education benefits have a more pro-poor incidence than other forms of education, for example, suggests that a shift in resources from secondary to primary education would have a positive distributional impact (if only because the poor have more children enrolled at the primary levels). Nevertheless, the marginal incidence of this change may differ greatly from what one might expect based on total incidence calculations.[11] If the goal were to increase coverage and retention, the distribution of marginal benefits would likely be more pro-poor than that of average benefits. An impor-

tant consideration in this regard is whether the marginal expenditures help to remove barriers to enrollment and attendance facing the poor, such as high out-of-pocket costs and forgone earnings (especially at the secondary level). In contrast, if the aim were to increase quality, that process might well begin in the big cities and in the better-off school districts, causing the marginal incidence to be less pro-poor than on average. This would be particularly true if improvements in quality prompted nonpoor students in private schools to shift into public schools. Because a gap can often exist between marginal and average incidence, the most policy-relevant incidence analyses focus on narrowly defined policy changes, such as those examined below.

Measuring the Benefit from a Change in School Fees

An important policy question concerns the incidence of increased fees for public schools (these issues are discussed in Jimenez 1986, 1987, 1989, as well as in the introduction to Gertler and Glewwe 1990). Within the binary choice model presented above, the CV for an increase in public school fees, Δf, is

$$CV_2 = -\int_{P_0 + w_0}^{P_0 + w_0 + \Delta f} s^c(z, q, U)dz. \tag{7-7}$$

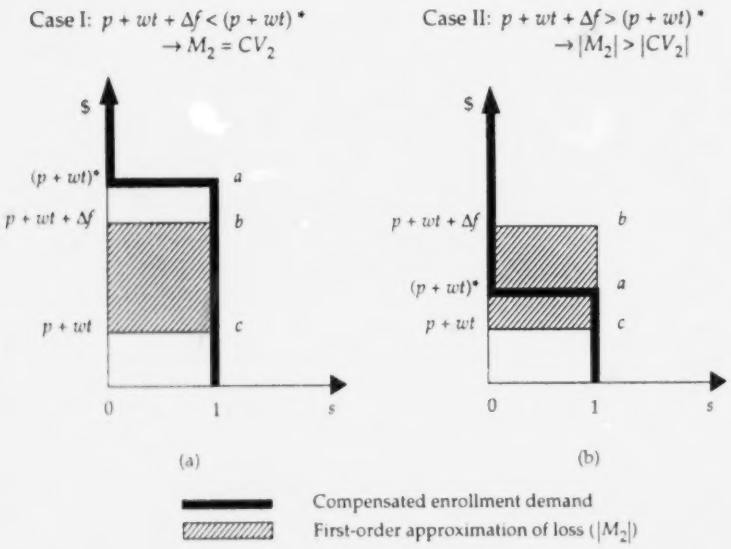
An alternative measure that does not require demand-curve estimation is simply

$$M_2 = -s\Delta f. \tag{7-8}$$

Indeed, for a small enough change in fees, Small and Rosen's 1981 discrete-choice analog of Roy's Identity demonstrates that M_2 is exact. Intuitively, enrollment frequencies can be interpreted as first-order approximations of the loss in benefit from a $1 increase in school fees. Of course, for larger changes in fees, this first-order approximation *overstates* the loss in benefit from an increase in school fees, because it ignores the possibility that the child would withdraw from school as a result of the price change (thereby avoiding any further losses from higher fees).

Figure 7-2 illustrates this potential bias. In graph a, the increase in fees would not induce the child to drop out, so the fee increase would, in essence, be a lump-sum tax equal to the welfare loss. In graph b, the increase in fees *would* induce the child to drop out, so that only a portion of the fee increase would constitute a welfare loss. Nevertheless, note that while M_2 may tend to overstate the private losses per child, CV_2 may understate the social losses associated with fee increases. External benefits, short planning horizons, and intrahousehold inequity are among the many reasons why there may be positive social net

Figure 7-2. Potential Approximation Error in the Case of a Discrete Fee Increase



benefits from enrollment that are not reflected in CV_2. If so, it is an open question whether CV_2 or M_2 provides the more accurate measure of welfare loss.

Measuring the Benefit from Reduced Travel Time

An important policy issue concerns building new schools to reduce travel costs for communities located far from existing schools, with expenditures being financed with higher school fees. Closer schools would reduce the magnitude of both forgone labor earnings and out-of-pocket travel expenses. Closer schools may increase the quality of the schooling option (Gertler and Glewwe 1990), through reductions in both student fatigue and any risks associated with extensive travel. Closer schools also enable parents to play a more active role in the education process. For all of these reasons, closer schooling would benefit households that currently enroll their children and may increase enrollment. At the same time, increased school fees would work in the opposite direction, reducing enrollment and the benefit derived therefrom.

Gertler and Glewwe (1990) address the willingness to pay for closer secondary schooling by examining the fee change that would make

households indifferent between the status quo and a policy of closer, but more expensive, secondary schooling. Letting q be a function of t, they compute the following CV for reduced distance to school:

$$(7\text{-}9) \qquad CV_3 = e[p_0 + wt_0, q(t_0), U_0] - e[p_1 + wt_1, q(t_1), U_0],$$

where $t_0 - t_1$ is the reduction in travel time, and where $p_1 - p_0$ measures only the difference in out-of-pocket travel costs (fees are held constant). Using this measure, they compute the average willingness to pay within each quartile (as a function of distance), which they then compare with the average cost of secondary schooling.

Several conceptual issues surround Gertler and Glewwe's compensating variation approach. First, even if average willingness to pay for closer schooling is substantial, it may be impractical to reduce travel times for widely dispersed students living in low-density rural areas. Policy conclusions are therefore best made in a community- and location-specific context, rather than on an aggregate basis. Second, their approach ignores any reductions in government expenditures associated with the decline in enrollment at more distant schools when students switch to the new, more proximate schools. Third, CV_3 measures the maximum payment a given household would be willing to make for closer schools, rather than simulating an actual fee increase. If the maximum willingness to pay varies and if schools are constrained to charge flat fees in order to avoid the stigma and administrative cost of charging differentiated fees, then the total revenue obtained by fee imposition would fall short of the community's aggregate willingness to pay. A more policy-relevant approach, for example, might be to compute CV_3 using a fee increase that holds net government outlays constant and then to examine the distribution of net benefits by income level.

In any event, calculating CV_3 entails estimation of household enrollment demands. It may also be possible to gain some insight into the willingness to pay higher fees without doing so. Consider the following statistic computed for children currently enrolled in school:

$$(7\text{-}10) \qquad M_3 = \Delta p + w\Delta t,$$

where Δp is the change in out-of-pocket transportation costs and Δt is the change in travel time. Intuitively, M_3 is a lower bound on the maximum fee increase that would make a household indifferent between the status quo and closer, but higher-priced, schooling. Indeed, for children currently enrolled in school, M_3 offers an exact answer to the question posed by Gertler and Glewwe so long as school proximity affects welfare only through its effect on forgone earnings and out-of-pocket travel expense. Of course, as in the case of CV_3, average levels of M_3 computed for a given community must be interpreted with caution if schools are constrained to charge flat fees. Moreover, some

children who are not currently in school may enroll (if the actual fee increase is small enough). Nevertheless, we believe that M_3, combined with information for each decile about enrollment rates and distance from school, can offer a useful perspective on the incidence of closer, but more expensive, schooling.

Empirical Results for Peruvian Education

In this section, we use the Peruvian Living Standards Survey data to construct the nonestimation-based incidence measures presented in the last section. Ideally, one would in each instance use the PLSS to construct the corresponding estimation-based measure, enabling a direct comparison of the two approaches. Our initial objective was to build on the estimation-based analysis of the PLSS in Gertler and Glewwe (1990). Unfortunately, this proved infeasible for a number of reasons. Chief among these is that the data did not enable Gertler and Glewwe to distinguish between public and private schooling nor to include the urban areas of Peru. As discussed, the PLSS does not contain sufficient price information to support such analyses.[12] Therefore, we primarily focus our analysis in this section on the nonestimation-based approaches presented above, though we compare our results with theirs whenever possible (for an analysis that directly compares estimation and nonestimation-based measures using a common data set, see Schwabe 1994).

The PLSS Data

The 1985–86 PLSS household survey data on education used in this chapter are from Peru's Instituto Nacional de Estadística (INE), as compiled by the World Bank's Living Standards Measurement Unit.[13] World Bank economists have also compiled a file with total real expenditures by household for 1985. The sample is self-weighting (nationally representative), including households from the metropolitan area of Lima, as well as from the rural and urban areas of the coast (*costa*), the mountains (*sierra*), and the jungle (*selva*).[14]

We use total real per capita expenditures as a measure of the living standard (thereby giving equal weight to each person in the household).[15] We then rank households into deciles (and the top 5 percent) based on their per capita real total expenditure. One problem in this regard is that nearly 15 percent of the school-age children in the PLSS data are recorded as residing in households other than those of their parents.[16] For such children, we know the household information for only their current (and presumably temporary) residences. We examine the ramifications of this issue in greater detail below.

Table 7-1 presents the mean household expenditure per capita, mean household size, and mean number of children in age categories six and under, seven to twelve, and thirteen to seventeen, for each decile. The highest two deciles account for about 52 percent of total expenditure. Both household size and the number of children in each age category decline as household per capita expenditure increases.

Our analysis utilizes data for 1980 through 1986 on current government spending for primary, secondary, nonuniversity, and university higher education from Peru's Ministry of Education. These data enable the computation of real current government expenditure per pupil, averaged over 1985 and 1986, by level of education. The data also report total capital spending (although not by education level). Capital spending is a relatively small part of Peru's education budget, averaging 5.48 percent of total current educational spending during the 1980 to 1986 period, although the percentage fluctuates during these years. Accordingly, we increase the current spending figure for each education level by 5.48 percent as a proxy for the benefits derived from the flow of services from capital.[17] The expenditure figures by level of education are presented in table 7-2.

Benefit-Incidence Analysis

To derive the incidence of public outlays on education by decile and region, we multiply the per pupil outlays in table 7-2 by the number of public pupils in each household at each level of education.[18] We then add scholarships awarded to students in the household to the outlay measures.[19] Next, we group the households by decile and region. Total outlays in each decile are then divided by the number of persons in the decile in each region. These are presented in table 7-3. Per capita outlays as a percentage of per capita household expenditure are presented in table 7-4.

On average, the fraction of the population enrolled in primary education is higher in rural than in urban areas. This is because (a) there are more children per household (at every age level) in rural areas, and (b) rural teenagers are far more likely than their urban peers to be enrolled in primary, as opposed to secondary, school. These demographic and enrollment patterns cause per capita primary education benefits to be higher in rural areas than urban areas. The reverse is true for both secondary and higher levels (in part because of lower enrollment rates, and in part because rural teenagers, when enrolled in school, are more likely than their urban counterparts to be enrolled in primary school). Of course, these results should be interpreted with care, because they are computed using national average expenditures. Insofar as per pupil expenditures are higher in urban than in rural areas, our conclusions regarding secondary and higher education hold

Table 7-1. Real Total Expenditure Distribution and Average Number of Children in Each Age Group, by Decile, Peru, 1985

Decile	Mean household per capita expenditure (1985 intis)	Household expenditure as a percentage of total	Mean household size	Mean number of children per household, by age group		
				0–6	7–12	13–17
1	932	1.7	6.5	1.6	1.2	0.9
2	1,609	2.9	6.1	1.4	1.2	0.8
3	2,161	3.9	6.1	1.3	1.2	0.7
4	2,693	5.0	5.9	1.1	1.0	0.8
5	3,335	6.0	5.8	1.1	0.9	0.7
6	4,113	7.5	5.2	0.9	0.8	0.6
7	5,049	9.0	4.9	0.8	0.8	0.6
8	6,430	11.7	4.7	0.7	0.7	0.5
9	8,857	16.2	4.5	0.6	0.5	0.5
10	19,645	35.6	4.0	0.4	0.4	0.4
Top 5 percent	26,646	24.1	4.1	0.4	0.4	0.4

Note: Households are ranked into deciles by household per capita expenditures.

Sources: Peru, Instituto Nacional de Estadistica (INE), Household Questionnaire, and the World Bank, Living Standards Measurement Unit.

Table 7-2. Average per Pupil Current and Capital Government Spending, Peru, 1985–86
(1985 intis)

Level of education	*Average*
Primary education	661.5
Secondary education	999.0
Tertiary education	
Nonuniversity	2,363.5
University	3,756.5

Note: The estimates reported are pupil-weighted averages of real current spending in 1985 and 1986 (the two years of the household survey), plus 5.48 percent of current spending as a proxy for capital expenditure.

Source: Ministry of Education, Government of Peru, made available to us through GRADE, a private research institute in Lima, Peru.

a fortiori, whereas primary education would be less "pro-rural" than our analysis suggests.

Given our concerns regarding the use of average per pupil expenditures, it is perhaps best to focus on incidence patterns within regions. Per capita expenditures on primary education are about the same for the first seven rural deciles and somewhat lower for the three richest deciles. In contrast, in urban areas of Peru per capita expenditures on primary education are a steadily declining function of household per capita expenditure. This is due in part to greater enrollment in private schools in higher-income households and in part to differences in age composition and educational attainment, as discussed below. In particular, as in our urban/rural comparisons, there are important differences across deciles in the proportion of teenagers attending primary, rather than secondary, school. For example, figure 7-3 demonstrates that approximately half of the fifteen year olds in the lowest income decile who are in public school are enrolled at the primary level, while this percentage falls to zero in the highest decile.

Per capita government expenditures on secondary education present a somewhat different picture. In both the urban and rural areas of Peru, they first rise and then fall with income (an inverted-U shape). While secondary school enrollment in both public and private schools increases monotonically with income, pupils in the highest deciles are more likely to opt for private school and thereby forgo the benefits of public outlays. Finally, the benefits of higher education are pro-rich in both urban and rural areas.

When per capita public outlays are divided by per capita household expenditure, the resulting incidence patterns for primary and secondary education are pro-poor, while higher education is neither pro-rich nor pro-poor.

The findings of the above analysis are broadly similar to those found elsewhere in the literature, although education spending in Peru does

Table 7-3. Amount of Public Education Outlays per Capita by Decile, Region, and Level of Education, Peru, 1985
(1985 intis)

Region and level of education	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*Top 5*	*Average*
Rural												
Primary	85.2	91.0	86.0	83.6	83.1	83.7	84.1	60.4	43.0	69.6	71.5	84.4
Secondary	29.6	38.4	48.6	57.5	51.7	56.4	85.6	70.0	61.7	28.9	32.8	48.1
Higher	6.8	16.6	3.6	9.4	29.0	25.1	44.3	26.0	37.8	37.8	24.7	16.8
Urban												
Primary	105.9	89.4	87.0	86.1	81.1	60.8	68.3	59.0	36.8	23.4	21.8	65.2
Secondary	98.9	115.0	121.5	148.0	106.2	110.9	102.3	90.9	71.7	70.7	67.8	104.1
Higher	36.5	50.9	96.4	132.8	116.4	183.9	182.8	182.5	197.0	174.3	174.2	160.6
All Peru												
Primary	88.9	90.6	86.5	85.0	81.9	69.4	73.1	59.2	37.7	28.8	27.3	73.6
Secondary	41.9	59.5	80.6	107.9	84.2	90.4	97.2	86.7	70.3	65.6	63.6	79.4
Higher	12.1	26.1	44.2	78.1	81.1	124.4	140.4	151.1	173.8	157.6	155.7	97.2

Note: Average government outlays per student (not including fees), plus scholarships, divided by total population in each cell.
Sources: Peru, Instituto Nacional de Estadistica (INE), Household Questionnaire, and the World Bank, Living Standards Measurement Unit.

Table 7-4. Per Capita Public Education Outlays as a Percentage of Household per Capita Expenditure, by Decile, Region, and Level of Education, Peru, 1985

Region and level of education	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*Top 5*	*Average*
Rural												
Primary	9.4	5.7	4.0	3.1	2.5	2.0	1.7	0.9	0.5	0.4	0.3	2.8
Secondary	3.3	2.4	2.2	2.1	1.6	1.4	1.7	1.1	0.7	0.2	0.1	1.6
Higher	0.8	1.0	0.2	0.4	0.9	0.6	0.9	0.4	0.4	0.2	0.1	0.6
Urban												
Primary	10.1	5.6	4.0	3.2	2.4	1.5	1.4	0.9	0.4	0.1	0.1	1.0
Secondary	9.4	7.1	5.6	5.5	3.2	2.7	2.0	1.4	0.8	0.4	0.3	1.7
Higher	3.5	3.2	4.5	4.9	3.5	4.5	3.6	2.8	2.2	0.9	0.7	2.6
All Peru												
Primary	9.6	5.6	4.0	3.2	2.5	1.7	1.4	0.9	0.4	0.2	0.1	1.5
Secondary	4.5	3.7	3.7	4.0	2.5	2.2	1.9	1.4	0.8	0.3	0.2	1.7
Higher	1.3	1.6	2.0	2.9	2.4	3.0	2.8	2.4	2.0	0.8	0.6	2.0

Sources: Peru, Instituto Nacional de Estadistica (INE), Household Questionnaire, and the World Bank, Living Standards Measurement Unit.

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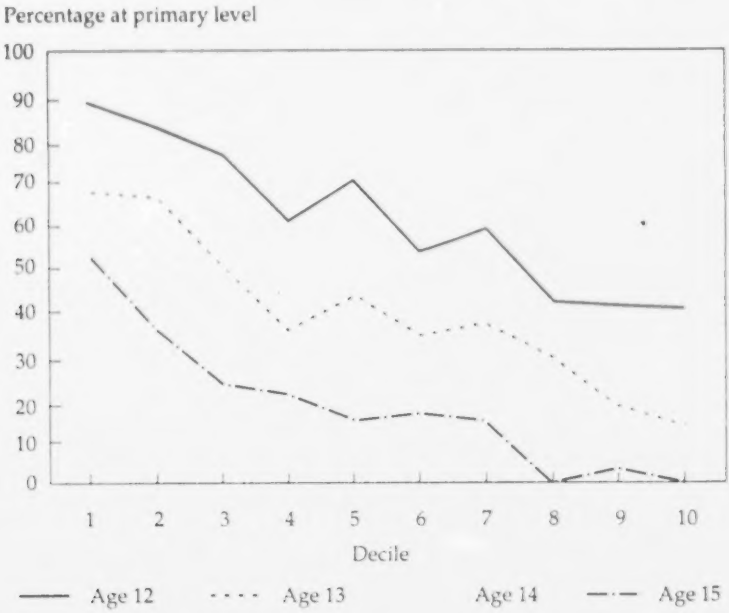
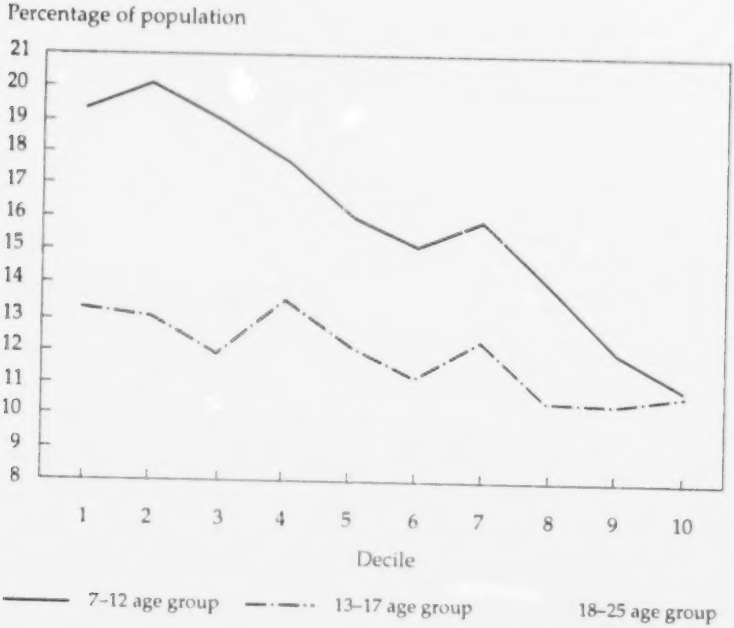
Figure 7-3. Enrollment in Public Primary Schools as a Percentage of Total Public Enrollment, by Age and Decile, Peru, 1985



not appear to be as pro-poor as in other countries.[20] Indeed, education would be substantially less pro-poor were it not for the large variation in age composition of the population (see figure 7-4). In particular, seven through twelve year olds constitute a differentially large fraction of the population in the lowest deciles, whereas eighteen through twenty-five year olds constitute a larger fraction in the upper deciles. (Percentages of thirteen through seventeen year olds are roughly equal among income groups.) Thus, age composition at least partially drives our finding that primary education is more pro-poor on a per capita basis than higher education.[21] As discussed in the preceding section, this may at least partially arise because households with young children tend to be headed by adults who have not yet reached their peak earnings. If viewed from a life cycle perspective, the progressivity of education spending may therefore be somewhat lower. Nevertheless, this approach offers useful insights into the success of the public education system in targeting resources at children who are in poverty at a given point in time. The next subsection illustrates that it can also be

Figure 7-4. Student-Age Population as a Percentage of Total Population, by Age and Decile, Peru, 1985



useful to compute benefits on a per child basis in addition to the per capita basis used to this point.

Incidence on a per Child Basis

In tables 7-5 and 7-6, we proceed as above to assign public outlays at each level of education (plus any scholarships received), except that we separate the population by age groups seven through twelve, thirteen through seventeen, and eighteen through twenty-one and divide the total outlays for primary, secondary, and higher education flowing to each cohort in each decile and region by the total number of children in the corresponding group. We also examine incidence by gender. This measure gives a better sense of the benefits accruing per child, because it controls for the effects of household size and educational attainment. Also, by focusing on children, it is possible to restrict the sample to those children who are recorded as residents of their parents' households (thereby ensuring correct expenditure imputations).[22]

Table 7-5. Amount of Public Education Outlays per Child, by Region, Age Group, Gender, and Decile, Peru, 1985
(1985 intis)

Region, age group, and gender		1	2	3	4	5	6	7	8	9	10	Top 5
Rural												
7–12	Male	340.6	347.9	417.9	372.8	486.2	429.7	421.6	369.7	428.0	375.9	319.5
	Female	278.4	345.3	409.4	364.2	390.3	321.8	464.6	355.8	438.5	368.6	538.6
13–17	Male	307.0	305.2	408.7	386.4	399.3	409.9	511.0	520.1	454.5	615.3	649.7
	Female	199.9	232.2	341.2	307.0	323.6	282.6	420.7	340.7	295.4	228.9	215.6
18–21	Male	106.1	154.1	162.5	132.2	309.2	291.4	199.3	22.6	92.9	186.4	194.8
	Female	44.7	140.5	32.6	134.2	82.9	106.8	131.7	246.9	288.5	279.8	467.8
Urban												
7–12	Male	437.1	470.3	478.0	486.5	490.3	468.5	398.3	452.5	379.9	337.4	409.2
	Female	425.3	395.2	418.9	481.8	487.9	436.0	425.7	447.0	339.6	328.0	306.6
13–17	Male	461.7	406.6	519.2	540.5	547.6	530.8	510.3	483.3	461.6	404.6	400.6
	Female	544.3	477.4	452.6	539.0	465.2	528.9	472.8	438.9	276.7	305.3	203.2
18–21	Male	304.2	212.5	359.7	508.9	349.9	587.4	597.8	675.0	556.8	621.8	776.6
	Female	107.6	344.9	263.1	594.9	364.0	354.6	449.6	414.4	512.7	439.4	433.6
All Peru												
7–12	Male	358.2	376.5	445.1	434.4	488.5	451.4	405.1	437.0	386.0	343.5	390.7
	Female	309.7	357.8	413.8	429.7	450.0	392.4	437.6	429.8	352.2	336.7	340.4
13–17	Male	334.3	333.1	467.4	483.6	490.5	489.7	510.6	492.8	460.6	413.4	416.5
	Female	249.1	321.7	391.2	454.2	411.5	437.5	456.9	415.9	279.5	297.0	204.8
18–21	Male	143.3	177.5	266.3	364.3	334.3	500.6	497.8	561.1	511.0	586.6	750.5
	Female	55.2	214.5	164.3	413.7	271.1	287.5	366.4	387.7	486.8	425.5	436.8

Note: For rural areas, the number of observations in the eighth, ninth, and tenth deciles becomes small for certain age groups, and grouping observations across these cells might provide a more accurate picture. Nonetheless, the general pattern of propoor benefit holds.
Sources: Peru, Instituto Nacional de Estadistica (INE), Household Questionnaire, and the World Bank, Living Standards Measurement Unit.

Table 7-6. Subsidy as a Percentage of Household per Capita Expenditures, by Decile, Region, Age Group, and Gender, Peru, 1985

Region, age group, and gender		1	2	3	4	5	6	7	8	9	10	Top 5
Rural												
7–12	Male	36.5	21.6	19.3	13.8	14.6	10.4	8.3	5.7	4.8	1.9	1.2
	Female	29.9	21.5	18.9	13.5	11.7	7.8	9.2	5.5	5.0	1.9	2.0
13–17	Male	32.9	19.0	18.9	14.3	12.0	10.0	10.1	8.1	5.1	3.2	2.4
	Female	21.4	14.4	15.8	11.4	9.7	6.9	8.3	5.3	3.3	1.2	0.8
18–21	Male	11.4	9.6	7.5	4.9	9.3	7.1	3.9	0.4	1.0	1.0	0.7
	Female	4.8	8.7	1.5	5.0	2.5	2.6	2.6	3.8	3.3	1.4	1.8
Urban												
7–12	Male	46.9	29.2	22.1	18.1	14.7	11.4	7.9	7.0	4.3	1.7	1.5
	Female	45.6	24.6	19.4	17.9	14.6	10.6	8.4	7.0	3.8	1.7	1.2
13–17	Male	49.5	25.3	24.0	20.1	16.4	12.5	10.1	7.5	5.2	2.1	1.5
	Female	58.4	29.7	20.9	20.0	14.0	12.9	9.4	6.8	3.1	1.6	0.8
18–21	Male	32.6	13.2	16.6	18.9	10.5	14.3	11.8	10.5	6.3	3.2	2.9
	Female	11.5	21.4	12.2	22.1	10.9	8.6	8.9	6.4	5.8	2.3	1.6
All Peru												
7–12	Male	38.4	23.4	20.6	16.1	14.6	11.0	8.0	6.8	4.4	1.8	1.5
	Female	33.2	22.2	19.1	16.0	13.5	9.5	8.7	6.7	4.0	1.7	1.3
13–17	Male	35.9	20.7	21.6	18.0	14.7	11.9	10.1	7.7	5.2	2.1	1.6
	Female	26.7	20.0	18.1	16.9	12.3	10.6	9.0	6.5	3.2	1.5	0.8
18–21	Male	15.4	11.0	12.3	13.5	10.0	12.2	9.9	8.7	5.8	3.0	2.8
	Female	5.9	13.3	7.6	15.4	8.1	7.0	7.3	6.0	5.5	2.2	1.6

Sources: Peru, Instituto Nacional de Estadistica (INE), Household Questionnaire, and the World Bank, Living Standards Measurement Unit.

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In the seven through twelve age group, males receive more benefits than females in almost every decile and region (though the differences are not always large). In the thirteen through seventeen age category, this gender gap is even more pronounced.[23] A similar pattern between genders emerges in the eighteen through twenty-five age cohort, although females in the three highest deciles in rural areas receive more education benefits than their male peers.

Outlays for the seven through twelve age group appear substantially less pro-poor when viewed on a per child rather than on a per capita basis. Indeed, public outlays received by children in this age group are neither pro-poor nor pro-rich. For the thirteen through seventeen age group, the incidence of outlays is pro-rich in rural areas, in part because many poor rural children in this age group continue to be enrolled in primary, rather than secondary, school. Incidence for this age group in the urban areas of Peru first rises and then falls with income (an inverted U-shape). This is because poor children have low enrollment rates at the secondary level, whereas the highest-income children, while typically enrolled in school, are more likely than their poorer peers to be enrolled in private schools. Finally, outlays per child in the eighteen through twenty-one age cohort tend to be pro-rich.[24] Overall, the incidence of education outlays per child is less pro-poor than the incidence of education outlays per capita. However, when outlays per child are expressed as a proportion of average per capita expenditures, the pattern is still basically pro-poor.

Private Costs of School Attendance

Based on the weight of the results reported so far and on the assumption that the benefit distribution of marginal public outlays will be similar to the benefit distribution of average public outlays, one might conclude that spending more at the primary level, while spending less at the secondary and higher levels, would better target educational benefits toward the poor. As discussed above, although the thrust of this argument is probably correct, it gives little guidance on how to target marginal public outlays to the poor. More spending will not necessarily mean better school attendance among poor children if there are barriers such as high out-of-pocket expenditures.

In an effort to examine such barriers to school attendance in Malaysia, Meerman (1979) computes out-of-pocket expenses for books, uniforms, transportation, forgone labor earnings, and other expenses that are likely to deter school attendance for lower-income children. He finds that such costs exceed 13 percent of per capita expenditures for the poorest 10 percent of Malaysia's households. Using regression analysis, Chernichovsky and Meesook (1985) find similar results in Indonesia. Moreover, they report evidence suggesting that long travel times may

hinder attendance. Both results may have important implications for efforts to target marginal schooling expenditures to children in the lowest deciles.

In table 7-7, we examine the PLSS reported annual out-of-pocket costs for fees paid to schools (net of scholarships received), transportation costs (excluding time costs), uniforms, books and supplies, and others. Especially in the poorest deciles, per pupil, these can amount to a substantial fraction of the household's per capita expenditure. These results suggest that the private costs of public school enrollment may be a formidable barrier for many poor children, highlighting the need for careful consideration of the marginal incidence of any policies intended to channel benefits to this segment of the population.

The Incidence of Higher School Fees

As discussed above, an important policy debate concerns increases in school fees. Advocates of increased fees argue that the additional revenues generated could secure enrollment expansion and quality increases that would generate positive net benefits. Opponents express concern that fee increases will be disproportionately borne by the poor.

As noted earlier, one can interpret enrollment rates as providing a first-order approximation of the incidence of a small change in fees. Table 7-8 presents enrollment rates, by age group, education level, and decile. These numbers are of interest in and of themselves as measures of the performance of the educational system. From this perspective, perhaps the most striking result to emerge is the high primary school enrollments in the thirteen through seventeen year old age group at all levels of income.

Moreover, when interpreted as first-order approximations of the welfare loss from an increase in school fees, the figures in table 7-8 suggest that a fee increase at the primary level would be roughly proportional on a per child basis and therefore regressive on a per capita basis (because poor households tend to have more young children than higher-income households). A fee increase at the secondary level would be less regressive, in part because poor thirteen through seventeen year olds are far more likely than their wealthier counterparts to be either enrolled in primary school or simply not enrolled in school.

Of course, numerous caveats can be raised concerning this approximation. On the one hand, approximation error due to the implicit assumption of inelastic demand may make fee increases appear more regressive than they in fact are. This would be the case if higher enrollment elasticities among the poor cause differentially higher dropout rates (so that welfare losses due to fee increases would be avoided to some extent). On the other hand, differentially large enrollment declines among the poor may themselves be of concern.

Table 7-7. Annual Out-of-Pocket School Expenditures per Pupil, by Decile, Region, and Level of Education, Peru, 1985
(1985 intis)

Region and level of education	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Rural										
Primary education										
Fees	0.8	1.4	−42.8	−4.4	−25.7	1.9	−37.6	1.6	3.6	3.2
Transportation	9.2	1.0	4.4	5.6	2.9	0.7	18.3	0.0	24.1	9.4
Uniforms	30.3	76.3	97.9	107.5	160.0	103.8	157.7	157.2	84.9	149.6
Books and supplies	55.5	56.8	60.5	76.0	78.9	89.7	104.4	77.6	154.3	121.1
Other	5.2	7.5	11.1	10.3	29.1	11.4	8.6	7.4	12.4	133.6
Secondary education										
Fees	5.0	3.6	−42.4	21.0	−14.9	5.8	−15.6	5.0	3.5	8.1
Transportation	28.6	6.6	30.2	129.5	52.6	18.4	50.6	0.0	44.7	53.4
Uniforms	144.8	142.6	236.6	232.2	358.1	312.8	387.1	309.2	297.1	187.2
Books and supplies	96.0	98.0	115.4	234.2	188.7	103.0	242.5	168.9	270.3	194.0
Other	10.7	19.0	16.4	42.3	15.4	25.0	22.6	12.7	41.3	28.1
Urban										
Primary education										
Fees	2.9	−2.2	4.7	4.5	5.3	13.0	11.2	8.5	29.0	−12.7
Transportation	3.0	8.5	15.2	16.5	16.7	14.7	10.1	62.2	37.7	86.1
Uniforms	60.7	143.5	155.1	166.7	216.5	221.6	239.4	415.4	285.8	294.1
Books and supplies	52.3	131.6	122.0	147.6	147.6	144.1	149.2	157.8	256.0	198.1
Other	4.7	7.9	9.6	10.6	28.0	25.7	40.6	29.2	48.6	25.9
Secondary education										
Fees	6.3	10.7	15.4	18.3	22.5	25.7	17.6	13.2	57.6	117.7
Transportation	22.0	33.4	23.6	29.5	54.2	35.9	40.5	48.2	48.4	38.2
Uniforms	94.2	142.6	215.1	238.0	268.6	250.7	297.2	412.2	473.8	516.5
Books and supplies	102.6	161.4	155.0	198.3	209.4	204.4	214.1	250.3	252.3	285.7
Other	11.7	19.9	22.1	20.5	33.6	23.6	38.7	40.0	49.5	65.4

Sources: Peru, Instituto Nacional de Estadística (INE), Household Questionnaire, and the World Bank, Living Standards Measurement Unit.

Table 7-8. Percentage of School-Age Population in Each Decile Enrolled in Public School, by Age and Level of Education, Peru, 1985

Age and level of education	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Primary education										
6–12	73.8	76.0	83.3	79.9	86.7	80.7	82.5	82.2	82.9	81.4
13–17	31.5	27.7	19.4	18.5	17.0	18.0	19.0	9.0	6.2	4.3
6–17	57.2	57.3	59.6	53.6	58.3	55.2	55.8	52.1	50.2	46.8
Secondary education										
13–17	24.1	32.6	51.2	58.8	59.7	61.4	563.9	71.7	79.8	79.6
18–21	12.0	15.6	22.6	27.7	15.7	18.8	21.5	14.0	13.9	14.8
13–21	20.5	27.1	41.4	48.8	41.7	44.7	48.5	51.5	53.0	54.8

Sources: Peru, Instituto Nacional de Estadística (INE), Household Questionnaire, and the World Bank, Living Standards Measurement Unit.

Table 7-9. Nonestimation-Based Evidence on Willingness to Pay Higher Fees to Reduce Travel Time to Secondary School, by Quartile, Peru, 1985
(percentage of eligible children)

Eligible children and travel time to nearest secondary school[a]	Quartile by household expenditure 1	2	3	4	Total school enrollment rate
Eligible children[b]					
0–30 minutes	19.2	38.0	47.2	51.8	37.7
31–90 minutes	33.4	26.3	21.2	22.7	26.4
91–150 minutes	19.9	12.5	13.0	15.6	15.6
Over 150 minutes	27.4	23.1	18.6	9.8	20.6
Eligible children who commute daily to local public secondary school[c]					
0–30 minutes	64.3	59.6	63.5	65.4	63.3
31–90 minutes	46.5	50.0	51.4	52.0	49.5
91–150 minutes[c]	14.3	29.2	29.4	35.5	28.2
Over 150 minutes[c]	0.0	12.0	0.0	25.0	5.6

a. Travel time to the nearest secondary school is reported for the community in which child is a resident.

b. Eligible children must be between ten and eighteen years old and have completed primary school (but not yet completed secondary school).

c. Calculations are based on fewer than forty children per cell, and should therefore be interpreted with caution.

Sources: Peru, Instituto Nacional de Estadistica (INE), Household Questionnaire, and the World Bank, Living Standards Measurement Unit.

Willingness to Pay Higher School Fees for Reduced Travel Time

As discussed above, preliminary evidence concerning the desirability of closer but more expensive schooling can be gained from readily calculated indicators of whether households are currently incurring substantial transportation expenses to send their children to school.

Using the quartile definitions employed by Gertler and Glewwe (1990), table 7-9 presents the distribution, by household expenditure quartile and distance to secondary school, of children aged ten through eighteen who live in rural communities and are eligible to enroll in secondary school.[25] As these results show, a substantial fraction of Peru's eligible children, especially among the poor, live more than 90 minutes from the nearest secondary school. Table 7-9 also presents current enrollment rates for each of these groupings. Not surprisingly, travel time appears to have an important negative effect on school enrollment (as was found by Gertler and Glewwe). For example, for the poorest quartile, 64 percent of eligible children who live 0–30 minutes away from a secondary school commute daily to that school; in contrast, only 14 percent of eligible children who live 90–150 minutes away from the nearest secondary school do so. Thus, one might well

expect shorter travel times to result in a substantial increase in enrollment (holding school fees constant).

Although these measures raise the possibility that closer but more expensive schooling would be welfare-improving in at least some communities, our estimates of M_3 do not reveal a substantial willingness to pay. Multiplying the reduction in travel time by the mean rural child wage rate and adding the average out-of-pocket travel costs reported by pupils traveling the corresponding distance, our estimate of willingness to pay for a one-hour reduction in travel time is only 77 intis per child per year (Peru's currency is the inti). For a two-hour reduction, the corresponding figure is only 110 intis per year. Children who are not currently enrolled in school would presumably exhibit lower willingness to pay for closer schooling. Clearly, these amounts fall far short of the average per pupil expenditure for secondary education of 999 intis (see table 7-2).[26]

Of course, as we note above, there may be quality- and learning-related benefits to school proximity that our crude measure ignores. Indeed, Gertler and Glewwe's estimates suggest that school proximity has a positive effect on enrollment in local schools independent of the effect of distance on expenditures. This may be one reason our estimates fall short of those presented by Gertler and Glewwe for reduced travel time to the local secondary school. Moreover, as noted above, a complete benefit-cost analysis must account for reduced spending associated with lower enrollment at the more distant schools, in addition to accounting for the increase in spending associated with the provision of more proximate schooling. Higher fees need only cover the differential outlays incurred by the government. For both of these reasons, we view our computations as a very first step in the development of nonestimation-based methods for assessing the demand for closer, but more expensive, schooling.

Conclusions

This chapter presents both a theoretical comparison of alternative benefit measures and an empirical application of nonestimation-based methods to issues surrounding public education expenditures in Peru. On the first point, we distinguish between benefit measures that involve the estimation of demand functions and those that do not. The latter include standard benefit-incidence analysis (which allocates government outlays in proportion to household use), as well as a number of other nonestimation-based methods that may be more appropriate for analyzing marginal changes in public policy.

Because estimation-based methods enable the researcher to construct estimates of compensating variation, such methods are generally viewed as being more firmly grounded in economic theory than the

nonestimation-based methods. However, we argue in this chapter that each of the methods has its own strengths and weaknesses. On the one hand, while the nonestimation-based approaches are less costly to implement and impose fewer data requirements, they clearly offer only approximations to the true willingness to pay. In particular, because these measures ignore any behavioral responses, they are especially inaccurate whenever elasticities are significantly large. However, this would only appear to be a serious omission to the extent that behavioral responses are known to be distributionally differentiated.

On the other hand, while the estimation-based approaches are more rigorously linked to an explicit model of consumer behavior, they typically have large informational demands and require strong assumptions about the functional form for household decisionmaking and about the distribution of the error term. Similarly, the private willingness to pay of the household decisionmaker may not be a good indicator of the social benefit derived from a child's education in the presence of externalities or intrahousehold inequity. Moreover, from the standpoint of analyzing capabilities rather than utilities, some of the nonestimation-based measures, such as government outlays per child, enrollment rates, and distance to school, may provide a more useful representation of the social value of education.

In its conception, our chapter would have compared the incidence results that others obtain using the compensating variation approach with those we obtain using standard incidence analysis and our other nonestimation-based measures. In its implementation, however, we have discovered that as extensive as the PLSS data are, important data limitations still face researchers seeking to implement demand-curve estimates. For instance, the data do not contain sufficient price information to distinguish between public and private schooling options in the rural areas of Peru, and price information is even more limited for Peru's urban areas. Similar problems are likely to confront researchers using other household data, so that it will rarely be possible to rely exclusively on compensating variation measures derived from demand-curve estimates, however desirable such measures are from the standpoint of economic theory.

In our empirical analysis, several results stand out. Using the benefit-incidence approach, we find that educational benefits are mildly pro-poor in Peru. A much lower proportion of poor children aged 6 through 12 are enrolled in primary schools compared to middle- and higher-income children. We also find that females of school age as a group receive fewer expenditures than their male counterparts as a result of differential enrollment rates.

Our analysis of the out-of-pocket expenses of attending school reveals that private costs represent a substantial barrier to participation for children in low-income households. These results parallel the findings

of several earlier studies and suggest that policies designed to increase enrollment rates among the poor should focus not only on reducing school fees but also on defraying the out-of-pocket expenses of sending children to school.

Our nonestimation-based analysis of the welfare effects associated with increasing school fees suggests that the incidence of losses would be regressive as a percentage of household income, although the largest absolute losses would fall on middle-income households. A similar analysis to gauge the willingness to pay for better proximity to schools suggests that a substantial fraction of households in rural Peru live far from the nearest secondary school. This is especially true for the poor (although the data reveal that households have overcome this barrier to enrollment with surprising frequency). Despite this, our results suggest that the potential reduction in travel expenses from more proximate secondary schools falls well short of the average cost of secondary schooling. However, our nonestimation-based approach neglects many potential benefits, such as reduced travel fatigue and an associated increase in learning. Moreover, one must factor in cost savings at the more distant schools as children switch to the local facilities.

Our empirical analysis leads to several strategies that Peruvian policymakers might employ to improve the targeting of public education expenditures in Peru. At the most basic level, because primary education is more pro-poor than secondary or higher education, reallocating government resources toward primary education is likely to be pro-poor. In particular, the pro-poor pattern reflects the fact that a substantial fraction of poor children are enrolled in primary school up to the age of fifteen or sixteen years old (an issue that itself deserves additional analysis).

However, even at the primary level, the incidence of government outlays on a per child basis is approximately proportional. Because of this, and because out-of-pocket expenses and the opportunity cost of forgone labor pose important barriers to enrollment by poor children, policies to reduce schooling costs for the poor would probably have a more progressive incidence than a general increase in expenditures at the primary level.

With regard to the incidence of closer but more expensive secondary schooling, our results are mixed. Closer schools would probably be pro-poor, simply because the poor tend to live farther from the nearest secondary school. However, the welfare effects of closer schooling should be examined carefully on a community-by-community basis, especially in light of our finding that potential savings in travel costs are unlikely to justify large increases in school fees.

Notes

1. A partial list of other references includes Dor, Gertler, and van der Gaag (1987); Gertler and van der Gaag (1988); Gertler, Locay, and Sanderson (1987); and Ellis and Mwabu (1991).

2. Early studies of high-income countries include Gillespie (1965); Tax Foundation (1967); Maital (1975); Musgrave, Case, and Leonard (1974); and Reynolds and Smolensky (1977). A partial list of other developing-country studies includes the early studies by Foxley (1979) and Sahota (1977), as well as more recent studies by Bahl, Kim, and Park (1986); Meesook (1984); Petrei (1987); Riboud (1990); and van de Walle (1992).

3. Selden and Wasylenko (1992) review the recent literature on standard benefit incidence. For reviews of the earlier benefit-incidence literature, see De Wulf (1975, 1981).

4. The model therefore ignores issues surrounding attendance.

5. It is unlikely, however, that the entire time devoted to schooling would have been spent in employment at wage rate w, especially for younger children. To the extent $t < t_s + t_t$, the willingness to pay computed from demand-curve estimates would be overstated. Lower opportunity costs from forgone labor would also result in lower willingness-to-pay estimates for reduced travel time (see below).

6. An alternative measure, the equivalent variation (EV), replaces the status quo utility with the utility level if no public schooling option is available. Both are valid money metric measures of utility; however, the EV is preferable when multiple policy changes are being considered (L. W. McKenzie 1957; G. W. McKenzie 1983; King 1983).

7. In this regard, although most faraway schools are indeed private, the local schooling option includes both public and private schools.

8. Data permitting, an alternative way to address quality differences without estimating demand curves is to examine the incidence of qualified teachers, free textbooks, travel time, and other quality-related variables. This requires data on school quality only for the option actually chosen.

9. For instance, public expenditures on education may crowd out private transfers that would have helped to finance education in the absence of such expenditures. Developing-country studies of public and private transfers include Cox and Jimenez (1990) and Rempel and Lobdell (1978). Also, see Lampman and Smeeding (1983).

10. Choosing between a current versus a lifetime perspective is the subject of a well-known debate on the California education system between Hansen and Weisbrod (1969) and Pechman (1972). For an excellent example of a lifetime incidence analysis of *social security* benefits in a developing-country context, see Burkhauser (1986).

11. Selden and Wasylenko (1992) discuss this in greater detail. Also, Piggott and Whalley (1987) provide simulation results demonstrating that marginal and average calculations of benefit can yield very different conclusions about incidence even in the case of a pure public good.

12. Moreover, an unresolved issue is whether the coefficient estimates published in Gertler and Glewwe (1990) imply a negative marginal utility of income for at least some deciles. The marginal utility of income in their quadratic specification is $\lambda = \alpha_1 + 2\alpha_2 c$, where c denotes per capita consumption. The authors have clarified that α_2 in table 6 of their paper should be -0.031 rather than -0.31. However, this does not, by itself, eliminate the problem of λ being negative.

13. We are grateful to the government of Peru for their permission to use their data for our project. We also thank Kalpana Mehra of the World Bank for supplying the data to us on tape.

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14. However, certain politically unstable portions of the *sierra* are not represented in the PLSS.

15. Note in this regard that the price indexes attached to the PLSS are region specific. One might ideally use adult equivalency scales to deflate total expenditures. However, there is no accepted equivalency scale measure. Deflating by the number of persons in the household also maintains comparability of our results with those obtained in other studies, which do not in general use equivalency scales. For an excellent discussion of equivalency scales, see Deaton and Muellbauer (1980, chap. 8).

16. One reason may be that the children have moved into a relative's household for education purposes. The residency requirement for the PLSS is three months.

17. Meerman (1979) shows that omitting the flow of capital services from benefit measures can seriously misrepresent the benefits of public spending. Although we were unable to obtain an accurate measure, capital spending was only a small part of total education spending in Peru during this period.

18. This is straightforward for primary and secondary education. However, the PLSS does not enable one to distinguish between current enrollment in university and nonuniversity forms of higher education. For our calculations, we simply use an (unweighted) average of the per pupil costs of the two forms of schooling. This may slightly understate the magnitude of the higher education benefits (because the higher-cost universities serve more students than the nonuniversity alternatives). More significantly, the fraction of pupils completing at least one year of university education (as opposed to nonuniversity education) is an increasing function of income, so that the incidence of higher education benefits may be more pro-rich than our measures suggest.

19. Most scholarships are public. In any event, this does not qualitatively affect our results.

20. Among the better-known studies are Meerman (1979) for Malaysia and Selowsky (1979) for Colombia. Other studies include Bahl, Kim, and Park (1986) for the Republic of Korea; Foxley (1979) and Castañeda (1989) for Chile; Jallade (1974) for Colombia; Das Gupta and Tilak (1983) for the West Godavari District of the Indian state of Andhra Pradesh; Meesook (1984) and van de Walle (chapter 9 of this volume) for Indonesia; and Petrei (1987) for five countries in Central and South America. Though conducted at different times and in different countries, the results of these studies are largely congruent. In all cases, primary education is at least weakly pro-poor in absolute terms—and strongly pro-poor as a percentage of income. Secondary education presents a more mixed picture. All studies find secondary education to be less pro-poor than primary education. However, although most studies find secondary outlays to be pro-poor, Meerman finds a proportional distribution of secondary outlays in Malaysia (in absolute terms), while Meesook finds a pro-rich distribution in Indonesia (in absolute terms, but not as a percentage of income). Higher education is typically found to be pro-rich (this is often true even when outlays are calculated as a percentage of income).

21. For example, a household with four adults and one school-age child would have outlays for the child in school imputed to the household, but the expenditure would be deflated by the number of persons in the household.

22. This procedure is also followed by Gertler and Glewwe (1990 and 1992). Many children who attend faraway schools are still included (so long as they are listed as residents of their parents' households). Nevertheless, children who reside with relatives for education purposes may be underrepresented in the sample as a result of this procedure. Although this might be especially

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problematic in the context of an education analysis, in practice our calculations using the full sample of children yield similar results to those presented here.

23. Gertler and Glewwe (1992), using the same data that we use, find that the willingness to pay for reduced travel time to secondary school is lower for females than for males.

24. For this age group, the most reliable calculations are those for all of Peru, because some of the cells in tables 7-5 and 7-6 have fewer than forty observations.

25. Our sample differs from theirs, however, insofar as theirs excludes a large number of observations for which parental education data are missing. Such data are not required for our calculations, so we do not exclude these observations.

26. Note that this is more than twice the per pupil cost used by Gertler and Glewwe. Their cost estimate has the advantage of being specific to rural Peru (ours is a nationwide average). However, to obtain this estimate, they simply divide the average teacher salary by an assumed class size of thirty.

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